Geology 376-2, Spring 2004, Final Assessment

This course was an experiment in cross-disciplinary teaching. Perhaps the course will be taught again, either at this university or elsewhere. I already have some ideas for how to improve it; I would like your suggestions. At the end there is a pop quiz.

Lectures: Most of the class periods were lectures on mathematical topics, including calculus, linear algebra, differential equations, numerical methods, vector calculus, fluid dynamics, and Fourier analysis. How much of these topics did you know beforehand? Was the pace too fast or too slow? Which topics should be covered in more or less depth? Did you feel comfortable asking questions? How might the lectures be improved? How might we integrate geological content more?

Discussions: Each student led a discussion on a specific paper or topic. How could these discussions be improved, in format or organization? What did you think of the other students' presentations? How many of the papers did you read, in enough depth that you felt you could participate? How many of the papers did you find interesting? Did you feel that the lectures helped you understand the papers?

Homework: There were four homework assignments, on calculus, linear algebra, linear ODE, and vector calculus. How much time did you spend on the homework? Was it too easy or too difficult? Do you think it helped you understand the concepts? How might the homework be improved? Should there be more or less of it? Was the grading adequate?

Group Work: A few class periods were spent doing group work on linear ODE and vector calculus (the last two homework assignments). Do you find group work valuable? Should there be more or less of it?

Labs: We had two laboratory exercises involving MATLAB. (A third lab was planned, but we ran out of time.) Did you have any prior experience in programming? Had you ever used MATLAB before? Do you feel comfortable using it for computational tasks now? Were the labs too easy or too difficult? How much time did you spend on them? How might they be improved? Was the grading adequate?

In General: Is a course in "mathematical methods in geology" a good idea? If so, how would you design the course, ideally? Which are the important topics to cover? Which topics do you wish we'd covered? Should the course cater to all students of geosciences, or should it focus on one area? Is there anything else you'd like to recommend?

Fluids: To me, a fluid flow is simply a differentiable function $u : \mathbb{R}^4 \to \mathbb{R}^3$. In what way does this function u describe a flow? What physical principle did we use in deriving the Euler and Navier-Stokes equations? What assumption makes Euler's equation simpler than Navier-Stokes?

Vector Calculus: We have discussed scalar and vector fields on $\mathbb{R}^3$. Please tell me everything you know about the gradient. You might discuss which kinds of fields it takes as input and produces as output, the definition of the gradient, any identities that relate the gradient to curl, divergence, or the Laplacian, how the gradient relates to potential functions, and any physical intuition you have for the gradient.

Linear Algebra: Let $f : \mathbb{R}^3 \to \mathbb{R}^3$ be a linear transformation. Assume that the determinant of f is 0. Tell me everything you then know about f. You might want to discuss the inverse, kernel, range, and eigenvalues of f, as well as properties of a matrix representing f.